

## REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the remarks that follow.

The Agent for the Applicants met with the Examiner on December 20, 2011, for an Interview, and Applicants thank the Examiner for the courtesies extended during the Interview. During the Interview, the invention, pending claims, and prior art were discussed, as well as the experimental evidence showing unexpected advantages that is provided in the attached Declaration.

### ***I. Claim Status***

Claims 57, 58, 62, 63, and 64 have been amended. Upon entry of this Response, claims 57-60, 62-76, and 79-80 will be pending and under examination.

Claims 57 and 64 have been amended to reduce the thickness of the nanosheets from 2 nm or less to 1 nm or less. Claim 58 has been amended to delete the limitation on the thickness of the nanosheets, made unnecessary by the amendment to independent claim 57. Claim 62 has been amended to incorporate an additional limitation requiring the thickness of the nanosheet to be 1 nm or less. Claim 63 has been amended to incorporate additional limitations regarding the height of the nanosheets. Support for these amendments can be found throughout the specification as filed, for example, in paragraph [0054].

### **II. Claim Rejections – 35 U.S.C. § 103**

According to the outstanding Office action, claims 57-59, 75 and 79 presently stand rejected under 35 U.S.C. § 103(a) as unpatentable over Wu et al., (*Adv. Mater.* 14(1), (2002), pp 64-67, hereafter “Wu”). Claim 60 presently stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Wu as applied to claims 57-59, 75 and 79 above, and further in view of *Carbon*, (39) 2001 505-514 (“Peigney”). Claims 62-64, 76 and 80 presently stand rejected

under 35 U.S.C. § 103(a) as being unpatentable over Wu in view of Peigney. These rejections are respectfully traversed as follows.

Applicants submit that the standard of obviousness requires a consideration of whether the subject matter, taken as a whole, would have been obvious at the time the invention was made to a person skilled in the art. The PTO states that Wu teaches carbon nanowalls of 10 nm or less, that a *prima facie* case of obviousness exists, and that Applicants have not adequately rebutted the *prima facie* case of obviousness. Applicants agree that a *prima facie* case of obviousness exists, and herein rebut the *prima facie* case of obviousness by pointing out the unexpected advantages of the claimed range of carbon nanosheets of 1 nm or less. The unexpected results of the claimed invention are discussed in detail in the accompanying Declaration by Dennis M. Manos, Ph.D., under 37 C.F.R. § 1.132, an inventor of the claimed subject matter. The unexpected results of the claimed range of carbon nanosheets, relative to other thicknesses of carbon nanowalls, were not obvious at the time of the invention to a person having ordinary skill in the art.

According to MPEP 2144.05, “Applicants can rebut a *prima facie* case of obviousness based on overlapping ranges by showing the criticality of the claimed range. ‘The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.’ *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990).”

While Wu teaches carbon nanowalls having a thickness of less than 10 nm, neither Wu nor others at the time of the invention were aware of the substantial improvement in properties of the claimed carbon nanosheets. The unexpected advantages are described in the accompanying Declaration, and summarized below.

Field emission properties of carbon nanosheets having a thickness of 1 nm or less (3 atomic layers or less) were compared with field emission properties of carbon nanowalls of approximately 2.5 nm thickness (approximately 8 atomic layers), and the advantages of the carbon nanosheets within the claimed range of 1 nm and below were enormous, including orders of magnitude improvement in current flow over a range of applied fields. This is a

direct comparison, and shows the dramatic difference in field emission properties, a difference in kind rather than one of degree.

This impressive difference in field emission properties was recognized by Applicants at the time of filing. For example, in paragraph [0055] of the specification, Applicants stated that "smaller thicknesses, such as 1 nm or less, are preferred for applications exploiting the magnetic or field emission properties of CNF". Furthermore, FIG. 7 shows a field emission curve showing the superiority of the claimed carbon nanosheets relative to carbon nanotubes. Applicants clearly possessed the invention as of the filing date, and the accompanying Declaration simply provides a more straightforward demonstration of the unexpected results by directly comparing the claimed carbon nanosheets to thicker carbon nanoflakes.

This evidence of unexpected results does not constitute new matter. As mentioned above, Applicants clearly had possession of the claimed invention at the time of filing. The Examination Guidelines for Determining Obviousness Under 35 U.S.C. 103 (see MPEP 2141) state: "Objective evidence relevant to the issue of obviousness must be evaluated by Office personnel. *Id.* at 17-18, 148 USPQ at 467. Such evidence, sometimes referred to as "secondary considerations," may include evidence of commercial success, long-felt but unsolved needs, failure of others, and unexpected results. The evidence may be included in the specification as filed, accompany the application on filing, or **be provided in a timely manner at some other point during the prosecution.**" (emphasis provided)

MPEP 716.02 discusses allegation of unexpected results, and states that the court held that unexpected results for a claimed range as compared with the range disclosed by the prior art had been demonstrated by "a marked improvement, over the results achieved under other ratios, as to be classified as a difference in kind, rather than one of degree." This marked improvement, a difference in kind rather than one of degree, is exactly what Applicants have demonstrated in the Specification, and attested to in the attached Declaration.

MPEP 716.02(d) discusses unexpected results commensurate in scope with the claimed invention, and the PTO noted this point in the most recent Office action. Applicants note that the claimed range has been narrowed to carbon nanosheets having a thickness of 1 nm or less. As described above, Applicants specifically mentioned in the Specification that

carbon nanosheets of 1 nm or less thickness were preferred for applications exploiting their field emission properties.

Specifically referring to the rejections, Applicants believe that the evidence provided showing unexpected results, together with the claim amendments, is sufficient to overcome the obviousness rejection based on Wu. Wu taught carbon nanostructures of 10 nm or less, but did not teach or suggest the advantages of the claimed nanosheets. Furthermore, with respect to the claims rejected over Wu in view of Peigney, the teaching of Peigney does not remedy the deficiency of Wu. Applicants submit that the above-cited references fail to teach or predict the claimed subject matter taken as a whole. In particular, there is nothing in the cited references that suggests or predicts the unexpected (at the time of the invention) and dramatic benefits of the claimed carbon nanosheets.

Therefore, Applicants respectfully request withdrawal of these rejections, and believe that application is now in condition for allowance. If the Examiner has any questions regarding this response, a telephone call to the undersigned at (757) 221-1751 would be greatly appreciated.

Respectfully submitted,

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